XI. *Tranſlation of a Paſſage in* Ebn Younes; *with ſome Remarks thereon: in a Letter from the Rev.* George Coſtard, *M. A. Vicar of* Twickenham, *to the Rev.* Samuel Horſley, *LL.D. Sec. R. S.*

REV. SIR, Twickenham, Jan. 9, 1777.

Read Feb. 13, 1777. HAVING, by means of the Royal Society, been favoured with a tranſcript of the Arabic paſſage in manuſcript of EBN YOUNES, in the library at Leyden, I now ſend you as exact a tranſlation of it as I can. I give it you in Latin, as the former tranſlations of it were in that language; and as the numbers in the manuſcript by no means agree with calculations made by modern tables, I have ventured to ſuppoſe that they have been ſomehow or other altered from what they were in the original tables of EBN YOUNES. I have likewiſe ventured to ſuppoſe that the preſent Leyden copy is a tranſcript of another copy, which is no very violent ſuppoſition, conſidering how long ago theſe obſervations have been made, and how long it is ſince EBN YOUNES wrote.

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I have likewiſe made no ſcruple to ſuppoſe that, however diſtinct and elegant both the Arabic letters and figures are in later manuſcripts, they were not ſo in thoſe of a more ancient date, ſo that the one might eaſily be miſtaken for the other, where there is a ſimilarity: and this miſtake would be the more eaſily committed by a perſon ignorant of the ſubject he was upon. This probably was the caſe of all ſuch as were hired by bookſellers to tranſcribe manuſcripts for ſale; and for this reaſon, when the tranſcriber had made any miſtake, he would not blot it out for fear of ſpoiling the ſale of his book.

There is an inſtance of this ſort in this very manuſcript in the obſervations of the third eclipſe, which is that of the Moon, as you will ſee in the tranſcript and tranſlation ſent you laſt year by Mr. SCHULTENS.

If what hath been ſaid be allowed me, as I hope it will not be thought too much, I think I ſhall be able to account poſſibly, if not probably, for the differences between the obſervations as ſet down in the manuſcript, and the reſult of the calculations by modern tables: a thing which hath not been hitherto attempted, as few who have been verſed in aſtronomy have been acquainted with the Arabic language; and they on the other hand, who have well underſtood Arabic, have been as little converſant with aſtronomy.

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What I have now advanced ſhall be exemplified under the firſt eclipſe, which is one of the Sun.

In this eclipſe, according to the manuſcript, at the beginning, the Sun's altitude was more than 15 (يه) degrees, and leſs than 16 (يو); and at the end it was more than 33 degrees (لج) and $\frac{1}{3}$. But I make the Sun's height at the beginning 30 (ل) degrees, and at the end nearly 36 (لو). In the manuſcript, the digits eclipſed are ſaid to have been 8 (ح, or ٨, as it is ſometimes written); but I make them only a little more than 4(د), or about $4\frac{4}{5}$.

Whether the notation in the original manuſcript of EBN YOUNES was in letters or arithmetical figures is uncertain; but moſt probably it was in the former of theſe two, as it is in moſt of the tables now extant, though compoſed ſince the admiſſion and uſe of arithmetical figures. Upon this ſuppoſition then, or that they were ſo in the manuſcript from whence the preſent manuſcript was copied, we ſhall very naturally account for the miſtakes we find in it.

Thus for inſtance, ل by ſome accidental ſtroke at the bottom, would eaſily be taken for ـل, as ـلا is ſometimes written in manuſcripts; and if the perpendicular ſtroke in the ل was made ſhort, as in a table it very well might be, ل (30) would naturally be taken for ـلـ or يه (15); and,

by the ſame rule, لو (36) would very eaſily be taken for يو (16); and ه (4) the digits eclipſed for ٧ which is 8 in the other form of notation, or ٨ in this.

In the manuſcript it is ſaid, that the Sun's altitude at the end, by obſervation, was a little more than 33 (لج) degrees; but this would, in a manuſcript ill writen, eaſily be miſtaken for لہ (35) or لو (36).

As to the words, tranſlated by Profeſſor SCHULTENS for Mr. GRISCHOW, "accidit hoc in plano circuli ejus "minus quam 7 digiti," I am apt to ſuſpect they are nothing more than ſome marginal reading crept into the text; that is, ſomebody ſeeing the digits eclipſed here made 8 (٨), added, as the Arabic will very well bear, "imo minus quam ز (7) or ٧ (7)," as in the other form of notation that figure is ſometimes made. The writer of this manuſcript, whoever he was, was certainly acquainted with both forms of notation, as he hath made uſe of both.

This interpretation is at leaſt plauſible, and clears up a ſentence which greatly perplexed both Mr. GRISCHOW and Dr. BEVIS, and ſeemed to them quite unintelligible.

The account given by CURTIUS of the ſecond eclipſe, which was a ſolar one, is this:

Anno eodem, die Sabbati, videlicet, 29 menſis Sywal, (numero decimi, qui Paſchalis eſt eorum) eclipſis Solis occupavit digitos $7\frac{1}{2}$. In principio, Sol altus ferè 56°. In fine, Sol occiduus elevabatur gradibus 26. EX SHICKARDO in MS.

This it is plain is not a tranſlation of the Arabic, for that, as tranſlated by SCHULTENS for Mr. GRISCHOW, and tranſmitted by him to Dr. BEVIS, is much fuller, and is as follows:

ECLIPSIS SOLARIS.

Hæc eclipſis extitit die Sabbati, 29 menſis Siewal, anno 367 Hegiræ. Et dies Sabbati hicce ipſe eſt dies 9 menſis Chordadma, anni 348 Jeſdagirdis, et ipſe 8 menſis Haziran anni 1289 Alexandri, et ipſe eſt 14 menſis Buna, anni Diocleſiani.

Fuitque maximum quod eclipſatum eſt de diametro Solis, 5 digiti et $\frac{1}{2}$ ſuper calculo accuratiore.

Erantque de plano circuli ejus 4 digiti et 10 minuta.

Et erat elevatio Solis, tempore quo eclipſis incepit, ſecundum oculum 56° circiter; et erat integra ejus reapparitio cum eſſet elevatio ejus 26 graduum, aut circiter; erantque Sol et Luna ſimul in hac eclipſi, in pro-

pinquo diſtantiæ maximæ a terrâ. Deus ſcit an calculus hic benè ſit poſitus. Tempus reſpondet diei 8 Jun. an. Chriſti 978.

Thus far Mr. SCHULTENS. And here I muſt obſerve that, according to him as well as CURTIUS, the Sun's altitude at the beginning was about 56°, or in Arabic notation نو; but by computation I make it only about 47° 50′. Suppoſe it were 47 (مز); then where the letters are ſmall and ill made, نو and مز may eaſily be miſtaken for each other.

The Sun's altitude at the end of this eclipſe, according to both CURTIUS and SCHULTENS, was 26° (كو); but by calculation I make it a little more than 36° (لو). But theſe figures are ſo nearly alike that they would eaſily be miſtaken by an ignorant tranſcriber, and from a manuſcript that was ill wrote.

How SCHICKARD, or CURTIUS for him, came to make the digits eclipſed $7\frac{1}{2}$ I know not: for in the manuſcript, as tranſlated by SCHULTENS for Mr. GRISCHOW above, we ſee they were only $5\frac{1}{2}$ and that *ſuper calculo accuratiore*, or as the Arabic ſhould have been tranſlated, *juxta calculum accuratiorem*. The meaning of which, I ſuppoſe, is that EBN YOUNES had found by calculation that the digits eclipſed would be $5\frac{1}{2}$, and that at the time his calculation agreed with his obſervation; as indeed it did,

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for I make them about $5\frac{3}{5}$, however widely this differs from $7\frac{1}{2}$ as in CURTIUS.

When the altitude of the Sun, at the beginning of this eclipſe, is ſaid to have been 56° or nearly, *ſecundum oculum*, it is evident that this was an obſervation.

When it is added, *erantque de plano circuli ejus* 4 *digiti et* 10 *minuta*, in words at length, it ſeems to have been ſome interpolation or marginal reading, crept into the text, as another ſeems to have done under the former eclipſe; for if the digits eclipſed here were $5\frac{1}{12}$, agreeable both to obſervation and *accurate caloulation*, they muſt certainly have been more than 4° 10′.

At the concluſion of the former eclipſe it was added in the tranſlation, Deus ſcit an *obſervatio* ſit benè inſtituta; and here the paſſage, as tranſlated, concludes with Deus ſcit an *calculus* hic benè ſit poſitus. But in the Arabic, as I have received it, there is no mention made either of *obſervation* or *calculation*. The words are the ſame in both paſſages, and are only *adjuvante Deo*. The other tranſlations ſeem only to have been what Mr. GRISCHOW collected from profeſſor SCHULTENS, who, he ſays, was totally ignorant of aſtronomical language, as he himſelf was ignorant of Arabic.

The third is a Lunar eclipſe; and the account given of it by CURTIUS, from SCHICKARD, is this:

Anno

Anno Chriſti 979. Anno Hegiræ 368 (qui incepit d. 8 Aug. mihi die 9 Aug. anno Chriſtiano 978) die Jovis, 14 Sywal, Luna fuit orta cum defectu, qui ad $5\frac{1}{2}$ digitos accrevit, cum extaret ſupra horizontem gradibus etiam 26 (ſubaudio finem tunc accidiſſe). SCHICKARDUS. Qui adjungit, tempus reſpondere diei 14 Maii, anno Chriſti 979.

The account of this eclipſe, as tranſlated by Profeſſor SCHULTENS for Mr. GRISCHOW, is more particular and intelligible.

Eclipſis Lunæ extitit in menſe Sieval (ſive Xaval) anno 368 Hegiræ. Orta eſt Luna eclipſata, in nocte cujus aurora fuit feria quinta. Et hæc feria quinta fuit dies 25 menſis Ijar, anni 1290 Alexandri, et ille 20 menſis Baſchner (ſive Pachon) anni 695 Diocleſiani.

Spatium quod eclipſatum fuit de diametro ejus, fuit amplius quam octo digiti, et minus quam novem.

Fuitque hora ortûs ejus proxima horæ oppoſitionis, ſecundum fundamenta quibus computare ſoleo.

Et perfecta eſt ejus reapparitio (ſive finis) cum præteriiſſet de nocte (i. e. poſt occaſum Solis) circiter hora juſta, et quinta horæ pars, prout obſervavi. Et erat Luna, in hac eclipſi, in propinquo diſtantiæ ſuæ mediæ.

Tempus reſpondet diei 14 Maii, anno Chriſti 979.

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With regard to the time of the oppoſition, and the Moon's riſing at Cairo, there is very little difficulty; for ſhe roſe there at $6^h\ 48'\ 10''$, and the time of oppoſition was at $6^h\ 24'\ 36''$.

The end of this eclipſe there was at $7^h\ 54'\ 26''$, and the time of Sun-ſet was at $6^h\ 47'\ 52''$. The difference is $1^h\ 6'\ 16''$, and agrees very well with the manuſcript.

The paſſage, as we have it here in CURTIUS from SCHICKARD, is very obſcure. For it ſeems either to mean that when the digits eclipſed were $5\frac{1}{2}$ the Moon was 26° high, or that ſhe was 26° high when the eclipſe ended. But I take the laſt to be intended; for the Moon was 26° high at $7^h\ 36'$, and the eclipſe ended, as we ſaw, at $7^h\ 54'\ 26''$.

But when SCHICKARD or CURTIUS ſay this *defectus ad* $5\frac{1}{2}$ *digitos accrevit*, the meaning muſt be that they amounted only to $5\frac{1}{2}$. But this is not true; for according to the manuſcript, they were between 8 and 9, and I make them about $8\frac{3}{5}$.

I am apt to ſuſpect, therefore, that the tranſcriber, whoever he was, caſt his eyes on the Solar eclipſe above, where the digits eclipſed are really $5\frac{1}{2}$, and careleſsly ſet them down to this Lunar eclipſe where they do not belong. And to confirm this conjecture it muſt be obſerved, that after the word *Diocleſian* under this Lunar eclipſe, in the Arabic follow *ſix lines*, which are a repetition.

tition of all that was ſaid under the laſt ſolar eclipſe, from the ſame word *Diocleſian* to the end of that obſervation.

I ſhall now, in the laſt place, give you a tranſlation of the Arabic paſſage intire, omitting however the interpolations mentioned above, which embarraſs the whole.

Infit ALI IBN ABDORRAHMAN, IBN ACHMED, IBN YOUNES, IBN ABDOL' AALI.

Imprimis, jam commemoravi eclipſes, tam Solares quam Lunares, quas obſervârunt viri docti; eruditi ii quorum nomina recenſui, quaſque ad eos retuli, *incipiendo* ab auctoribus libri dicti ALMOMTAHEN, uſque ad filios Majour; quin et conjunctiones eorum cum ſtellis fixis, quas obſervârunt, et quorum loca commemorârunt, et invenerunt, tempore conjunctionum eorum.

Ipſe deinde memorabo eclipſes quas obſervavi, tam Solares quam Lunares, et conjunctiones cum ſtellis fixis, et quænam fuerunt formæ eorum in conjunctionibus ſuis. Ut quicunque me ſequantur, et indicia habere deſiderent, meis utantur, quemadmodum ac ego eorum indiciis et directionibus uſus ſum, qui ante me obſervârunt. Deus autem adjutor eſt.

Eclipſis Solaris erat priore parte diei, feriâ quintâ, die decimo octavo menſis Rabiæ poſterioris, anno Hegiræ 367.

367. Et hæc feria quinta erat dies decimus ſecundus menſis Adzermah, anno Yezdagerdis 346.

Caraffæ adfuimus, in templo ABI GAAFARI ACHMED IBN NASAR Africani, cœtus eruditorum, ad hanc elipſin obſervandam. E quorum numero erat HAROUN IBN MOHAMMED AL GAAFARI, et ABU ABDALLAH AL HOSEIN IBN NASAR Africanus, et ABUL' HOSEIN ALI IBN MAHARBACHT Perſa, et ABUL' ABAS ACHMED IBN ACHMED AL CHURGII, et ABU ACHMED ASSUMACHI, et ABU OMAR Scriba.

Ex his, præter alios eruditos cum reliquis obſervatoribus, nonnulli erant aſtronomicè docti.

Ipſe quoque eodem contendi, unâ cum ABUL' KASEM ABDORRAHMAN IBN HOSEIN, IBN TISAN, AL IDAS, et HOSAN IBN AL DARANI, et HAMED IBN AL HOSEIN.

Et hi omnes initium hujus eclipſeos obſervârunt, quæ, ad ſenſum meum, apparere incepit ſole plus quam gradibus 15, minus autem quam 16 elevato.

Omnes quoque præſentes opinione conſentierunt obſcurari de diametro ejus circiter 8 digitos.

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Et ſplendor ejus perfectè recuperatus eſt cum elevaretur amplius quam gradibus 33 cum tertiâ ferè parte, prout ipſe menſuravi; omnibus qui aderant conſentientibus.

In hac eclipſi, Sol et Luna ſimul erant non longè a diſtantiâ ſuâ proximâ a terrâ. Adjuvante Deo.

ECLIPSIS SOLARIS.

Hæc eclipſis incidit in diem Sabbati, diem 29 menſis Shuwal, anno Hegiræ 367. Eratque hic dies Sabbati, dies 9 menſis Chordadmah, anno Yezdagerdis 347, et dies 8 menſis Hazirân, anno Alexandri 1289; et inſuper dies 14 menſis Bounah. anno Diocleſiani 694.

Maximum quod obſcuratum eſt de diametro ſolis erat $5\frac{1}{2}$ digiti.

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Et quando hæc eclipſis, ad oculi aciem, jam incepiſſe conſtabat, Solis altitudo erat circiter gradus 56, et lucis ejus reſtitutio completa eſt cum altitudo ejus eſſet 26 gradus, vel circiter.

Erantque Sol et Luna ſimul, in hac eclipſi, propè diſtantias ſuas maximas a terrâ. Adjuvante Deo.

ECLIPSIS LUNARIS.

Hæc contigit menſe Shuwal, anno Hegiræ 368. Oriebatur Luna, eclipſi jam inchoatâ, nocte cujus Aurora erat feria quinta, quæ feria quinta erat dies 28 menſis Ardbaheſt, anno Yezdagerdis 348, quæ fuit 18 menſis

Ijar

Ijar, anno æræ Alexandri 1290. Eratque dies 20 menſis Biſhnis, anno Diocleſiani 698.

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Eratque quantitas diametri ejus obſcurata, pluſquam digiti 8, et minus quam novem. Tempuſque ortûs ejus erat propè tempus oppoſitionis, juxta fundamenta quibus computavi: lucemque plenam recuperavit cum de nocte præteriiſſet hora circiter æquinoctialis, cum quintâ parte, prout ipſe conjectavi.

Eratque Luna in hac eclipſi, haud procul a diſtantiâ ſuâ mediâ a terrâ. Adjuvante Deo.

This I hope will be ſufficiently ſatisfactory.

I am, &c.